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Broadcast Seeding Success in Eight Pinyon-Juniper Stands After Wildfire

Susan Koniak[1]

ABSTRACT

Eight burns ranging from 1 to 18 years old in pinyon-juniper woodlands were examined to determine trends in establishment and survival of broadcast-seeded grass. The early plant communities following wildfire on low-elevation sites were dominated by annual forbs. Seeded grasses were present in small quantities on most sites, with highest occurrence on north slopes. On older burns, annual forb production has decreased and seeded and annual grasses and shrubs shared dominance. The effectiveness of broadcast seeding varied with each burn, aspect, and elevational class. Successful seedings generally can occur on all aspects and elevations if precipitation is normal or above normal the growing season following seeding. If precipitation is below normal, moderate seeding success may be achieved on high-elevation north- and west-facing sites (high-elevation east sites were not found) and low-elevation north-and east-facing sites. Seedling establishment and survival can never be assured because factors such as postseeding precipitation cannot be controlled.

KEYWORDS: broadcast seeding, pinyon-juniper, wildfire, vegetation establishment trends, vegetation survival trends, Nevada, California

Seeding following wildfire is often desirable to control erosion and rapidly restore or increase preburn levels of vegetation. Seeding methods that produce the best results include mechanical seedbed preparation and drilling (Vallentine 1971). Broadcast seedings are often cited as having low potential for success because of depredation of seeds by rodents, birds, and ants, inadequate moisture at the soil surface, and competition from aggressive annual plants (Nelson and others 1970; Campbell and Swain 1973; Goebel and Berry 1976). However, wildfire in pinyon-juniper woodlands in the Great Basin frequently occurs on steep, rocky terrain where only broadcast seeding is practical. This study examined trends in seeded species survival following broadcast seedings on seven burned sites in pinyon-juniper woodlands in Nevada and California. In addition, vegetational patterns on a 1-year-old burn were compared to those on older burns to determine the importance and longevity of initial establishment trends.

METHODS AND ANALYSIS

In 1981 and 1982, eight areas that were broadcast seeded after wildfire were located in pinyon-juniper woodlands in Nevada and California (table 1). On each burn the entire area or a representative part of the burn was surveyed to determine the plant communities present. Sites with major vegetational differences either in species composition or total biomass as well as sites that were similar vegetationally but varied markedly in elevation, aspect, or slope were sampled. Study sites were limited to areas with a minimum of 40 trees per acre (100 trees per hectare). At each site all species were recorded and canopy cover estimated according to the Braun-Blanquet cover-abundance scale (Mueller-Dombois and Ellenberg 1974). Elevation, slope, and aspect were measured. Only data from sites with slopes greater than 10 percent were used in the analysis.

Qualitative analyses were used to confirm apparent trends. Simple percentages indicated that portion of the total number of sites at north, south, east, and west aspect and high (≧7,000 ft [≧2 120 m]) and low (<7,000 ft [<2 120 m]) elevational classes with a specific range of cover of each vegetational class. Comparisons were made among these groupings and conclusions drawn.

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[1] Range scientist, located at the Intermountain Station's research work unit maintained in cooperation with the Renewable Resources Center, University of Nevada, Reno, Nev.

Table 1.—*Descriptions of eight pinyon-juniper burn areas in Nevada and California studied to determine success of broadcast seedings*

Study areas	Date of fire	Location description	Average elevation	Average annual precipitation[1]	Percent of normal precipitation in the calendar year following wildfire
			Feet *(m)*	*Inches* *(cm)*	
Big Creek (Nevada)	8/64	T17N R43S Sec 10,15,16	7,290 (2 220)	11.9 (30)	162
Gabbs (Nevada)	8/64	T12N R37E Sec 29	7,010 (2 140)	11.9 (30)	162
Wichmans (Nevada)	7/65	T8N R27E Sec 19,20,30	6,740 (2 055)	9.4 (24)	59
Rock Creek (Calif.)	7/73	T8N R23E Sec 27	6,200 (1,890)	9.4 (24)	85
Pine Nuts (Nevada)	8/73	T11N R22E Sec 19,30 T11N R23E Sec 24,25,36	6,765 (2 060)	12.9 (33)	66
Mt. Wilson (Nevada)	7/74	T4N R68E Sec 1-3,10-15, 21-28	7,160 (2 180)	13.1 (33)	97
China Garden (Calif.)	7/74	T7N R23E Sec 5 T8N R23E Sec 28,29,32,33	6,270 (1 910)	9.4 (24)	110
Slater Mine (Nevada)	8/81	T12N R22E Sec 4-8	6,600 (2 010)	12.9 (33)	[2]145

[1] Based on data from the closest weather station with approximately the same elevation.
[2] Based on data from January 1982 to October 1982.

RESULTS AND DISCUSSION

Establishment Patterns

The Slater Mine Burn was broadcast seeded only 5 months before sampling, and vegetation was still changing rapidly. Intermediate wheatgrass (*Agropyron intermedium* var. *intermedium*) was the dominant seeded species emerging on the Slater Mine Burn. Occurrence appeared to be directly proportional to the degree of establishment of other perennial species and indirectly proportional to the degree of establishment of annual vegetation (table 2). Intermediate wheatgrass was found at low levels of cover (<5 percent) on 100, 79, and 55 percent of the north-, west-, and south-facing sites, respectively (no east-facing slopes were found on the burn). Annual forbs dominated the vegetational response on all aspects of the burn. Cover on the south, and to a lesser extent west, aspects was substantially higher than on the north aspect. Annual grasses, primarily cheatgrass (*Bromus tectorum*), occurred on almost all south- and west-facing sites with cover on the south aspects greater than on west aspects. Only 15 percent of the north-facing sites had annual grass cover. In contrast, perennial species generally had higher occurrence and cover on the north aspect. Shrubs were present on 85 percent of the north-facing sites compared to 45 and

Table 2.—*Vegetational response following wildfire on the Slater Mine Burn indicated by percentage of sites with canopy cover of < 5 percent, 5 to 24 percent, and ≧ 25 percent*

Vegetation	Aspect	Number of sites	Percentage of canopy cover		
			< 5	5-24	≧ 25
Seeded grass	North	13	100	0	0
	South	11	55	0	0
	West	19	79	0	0
Native perennial grass	North	13	84	0	0
	South	11	100	0	0
	West	19	85	0	0
Annual grass	North	13	15	0	0
	South	11	54	18	18
	West	19	79	5	5
Shrubs	North	13	62	15	8
	South	11	45	0	0
	West	19	32	5	0
Annual forbs	North	13	16	54	30
	South	11	0	9	91
	West	19	0	42	58
Perennial forbs	North	13	54	38	8
	South	11	73	18	0
	West	19	63	37	0

37 percent of the south- and west-facing sites, respectively. Perennial forbs were present on most sites but have larger cover values on north aspects than on south or west. Native perennial grasses, however, were more prevalent on south slopes, but cover was low on all aspects.

Conditions on north slopes appear to favor the establishment of seeded grasses and other perennial species. North slopes generally have better moisture relations, less variation in temperature, and generally less harsh conditions than south and west slopes. Conditions limiting annual species occurrence may range from reduction in annual seed reserves in the soil as a result of long-term competitive advantage by perennial species in preburn stands to the occurrence of winter-acquired dormancy in many winter annuals (Baskin and Baskin 1981), which may be prolonged by the cooler temperatures and longer snow cover on north slopes. Site factors also appear to determine the early establishment patterns on south and west aspects. On these sites large daily temperature and moisture differentials, especially in spring and early summer, can easily damage susceptible seedlings. Annual species appear to survive these fluctuations better than most perennial species (Evans and Young 1982; Young and Evans 1982).

A number of vegetational patterns were apparent on the Slater Mine Burn. The longevity of these patterns and their effect on long-term survival of seeded species on this burn is not known. The following examination of vegetational patterns on seven older burns may provide some insight into the importance and longevity of early establishment patterns.

Survival Patterns

The other seven burns sampled varied in age from 5 to 18 years (table 1). Each burned area was vegetationally unique. Mt. Wilson at one end of the spectrum was almost totally dominated by seeded perennial grasses; Pine Nuts on the other end had predominantly annual vegetation (table 3). A high percentage (78 to 100 percent) of sampled sites from each burn had some degree of seeded grass cover. The variation in the percentage of burned sites with seeded grass cover of ≧25 percent ranged from 16 percent on Rock Creek to 100 percent on Mt. Wilson. The three burns with the least cover of seeded grasses (Rock Creek, Pine Nuts, and Wichmans) had the highest percentage of sites with shrub, annual vegetation, and native perennial grass cover of ≧25 percent, respectively. Following the seven wildfires, only these three areas had precipitation less than normal in the calendar year after burning (table 1). Wichmans and Rock Creek areas were seeded in August, contrary to recommended seeding in late fall or early spring (Vallentine 1971). Portions of the Pine Nuts Burn have been continuously grazed by livestock and wild horses since seeding, which may have further discouraged establishment of seeded grasses. Decreased precipitation, and to a lesser extent inappropriate seeding season and grazing pressure, appear to have been crucial in limiting seeding success on these sites. Each individual burn will not be discussed in detail. Data from Wichmans, Rock Creek, and Pine Nuts areas will be combined and compared with data from Big Creek, Gabbs, Mt. Wilson, and China Gardens (table 4). Trends will be discussed with sampled sites being combined into groups based on aspect and elevation.

Cover of seeded grasses was substantially greater on those sites with normal or above normal precipitation the calendar year following wildfire (Big Creek, Gabbs, Mt. Wilson, China Gardens) than on those sites with below normal precipitation during the same period (Wichmans, Rock Creek, China Gardens) (table 4). Cover of seeded grass on those sites with adequate precipitation was generally high over all elevations and aspects. Competition from shrubs may be a factor in reducing seeded grass cover on north slopes and high-elevation east slopes. On burned areas with less than normal precipitation following wildfire, annual vegetation or shrubs appear to have either actively limited seeded grass establishment or filled the void when seeded grass failed to establish because of environmental limitations. Those sites with comparatively low seeded grass cover have both high annual grass and high annual forb cover. Those sites with comparatively high seeded grass cover have substantial amounts of annual grass and shrubs, but cover of annual forbs never exceeds 25 percent. The only exceptions are the high-elevation west slopes, which have relatively high cover of all vegetation classes. Sites with the greatest potential for adequate soil moisture have the highest cover of seeded grass.

Table 3.—*Percentage of sites in seven burned areas with ≧ 25 percent canopy cover by six vegetational classes*

Study area	Number of sites	Seeded grass	Native perennial grass	Annual grass	Shrubs	Annual forbs	Perennial forbs
Big Creek	14	86	0	0	50	0	0
Gabbs	18	44	0	17	6	0	0
Wichmans	9	33	33	22	34	0	0
Rock Creek	19	16	5	26	58	0	0
Pine Nuts	73	27	1	78	22	18	5
Mt. Wilson	26	100	0	4	23	0	4
China Gardens	52	81	0	35	25	0	0

Table 4.—*Percentage of sampled sites from seven burns grouped according to aspect, elevation, and amount of precipitation the calendar year following wildfire with canopy cover ≧25 percent for four vegetational classes*

	Burned areas with below normal precipitation the calendar year following wildfire (Wichmans, Rock Creek, Pine Nuts					Burned areas with normal to above normal precipitation the calendar year following wildfire (Gabbs, China Gardens, Mt. Wilson, Big Creek)				
Aspect	Number of sites	Seeded grass	Annual grass	Shrubs	Annual forbs	Number of sites	Seeded grass	Annual grass	Shrubs	Annual forbs
All Elevations Combined										
North	50	34	38	50	0	47	66	23	32	0
South	11	0	81	0	45	12	100	17	17	0
East	6	33	83	17	0	25	80	12	24	0
West	34	24	94	12	23	27	89	30	15	0
Total	101	27	64	30	13	111	78	22	28	0
Elevation ≧7,000 Ft (2 130 m)										
North	7	29	29	86	0	13	54	0	38	0
South	4	0	100	0	50	12	100	17	17	0
East	–	–	–	–	–	14	71	7	29	0
West	8	62	88	38	25	12	91	17	17	0
Total	19	37	68	47	21	51	78	10	25	0
Elevation <7,000 Ft (2 130 m)										
North	43	35	40	44	0	34	71	32	29	0
South	7	0	71	0	43	–	–	–	–	–
East	6	33	83	17	0	11	91	18	18	0
West	26	12	96	4	23	15	87	40	13	0
Total	82	24	63	26	11	60	77	32	23	0

Environmental factors and competition work in concert to produce a variety of plant distributions which may or may not reflect the original establishment patterns. Annual forbs, so prevalent on the Slater Mine Burn, are found in substantial quantities only on burned sites with below-normal precipitation following wildfire and only on south and west slopes. Competition on all except the driest sites limits annual forb production. Annual species in general tend to be more prevalent on south and west slopes and shrubs on north slopes, similar to the patterns found on Slater Mine. The effects of aspect on the relative distribution patterns of annual vegetation and shrubs remain constant after establishment, regardless of postburning precipitation pattern or elevation. However, the precipitation levels following burning and elevation influence the relative quantities of these vegetation classes, principally by favoring the competitive ability of one class over another.

Distribution of seeded grasses over various aspects and elevations follows no distinctive pattern on the seven older burns. The high incidence of establishment on north slopes, as seen on Slater Mine, is not reflected in the cover values on older burns, probably because of shrub competition. Sites with high shrub cover and sites considered "dry" have reduced seeding success. High postburning precipitation appears to be the dominant environmental factor promoting seeded grass survival, ameliorating any adverse effects elevation or aspect may have. As a result, broadcast seeding success can never be assured because postseeding precipitation cannot be controlled.

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